臺灣地區 108 年中大型地震震源資訊之快速彙整與提供

The rapid integration of 2019 large earthquake source information in Taiwan

主管單位：中央氣象局地震測報中心

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摘要

臺灣位處於活躍的造山帶，菲律賓海板塊每年以 8.2 公分的速度向歐亞板塊聚合，使得臺灣地區地殼變動劇烈，活動斷層遍布且地震活動頻繁，災害性地震也經常發生。本整合型計畫對 2019 年花蓮規模 6.1 地震事件採用體波震源逆推方法，分析得出震源破裂過程的時間-空間分布，可於地震發生後快速建立震源破裂過程的初步結果，所建立之震源破裂模型亦可對於後續研究提供重要的資訊。

而本計畫也嘗試使用類神經網路技術應用於地震速報中，利用中央氣象局於全臺布署的地震測站，藉由測站收集之資料搭配類神經網路演算法進行各式應用，其中包含利用遞迴式神經網路的即時地震即時預警、定位以及利用深度卷積網路進行的 P 波 S 波標記任務，盼望可以利用類神經網路演算法減少人工資料上的處理以及應用於即時系統上增強準確度。

關鍵詞: 2019 花蓮地震、震源破裂過程、地震偵測、地震定位、類神經網路、人工智慧

Abstract

Taiwan is located on an active orogenic belt where the Philippine Sea plate converges toward the Eurasian plate with a speed of 8.2 cm per year. This rapid convergence induced dramatic crustal deformation, very active faults and high seismic activity over the past few years in Taiwan, and brought many earthquake disasters. This integrated plan analyzes the geological and seismotectonic of the seismic source area after the 2019 Hualien earthquake. By performing the body wave source inversion to analyze the time-space distribution of the source rupture process, which can quickly establish the preliminary results of the source rupture process after the earthquake.

This project develops three applications for earthquake detection by neural networks including earthquake detection and localization. For earthquake detection, recurrent neural networks have been used for real-time earthquake detection, while deep convolution neural networks have been used for P and S wave picking. For epicenter localization, an attention layer has been integrated with recurrent neural network for predicting epicenter in the early stage of earthquake occurrence. Extensive simulations were conducted to evaluate the performance of the developed schemes based on the collected earthquake waveforms in Taiwan. From the simulation results, the developed schemes outperform the traditional schemes in terms of time and accuracy.

Key words: 2019 Hualian Earthquake, time-space distribution of the source rupture process, Earthquake detection, earthquake localization, Neural network, Artificial intelligent